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consist principally of Bartlett, Howell, Duchess d'Angoulême, Lawrence, and Kieffer. Choicer varieties blighted badly in years past, and their cultivation was abandoned.

SYCAMORE BLIGHT.*

The Sycamore disease due to *Gloeosporium nervisequum* appeared suddenly at Dover, Del., between May 6 and 14. A special examination of a large tree was made on the first date to discover the blight, because it had appeared on the tree in previous years. Not a trace was found, but having occasion to pass the same tree a week later, dozens of blighted shoots and dead and drooping leaves were found on all parts. Immediately preceding this attack came a cold snap. On the morning of the 4th there was a white frost, on the 5th it was very cold, with a black frost at night, which destroyed the peach crop on flat lands. On the 6th it was still colder with a fall of hailstones. Following this and during the week in which the blight appeared came a hot spell. It was very warm on May 9, 10, and 11.

NEW FUNGOUS DISEASES OF IOWA.

By L. H. PAMMEL.

The following paper treats mostly of new diseases of plants, but reference will also be made to a few that have been the subject of recent papers. Its scope will be limited to such diseases as have been destructive to farming and horticultural interests during the past year in Iowa, since to do justice to the subject over the whole country would take too much time and space.

The subject can naturally be divided as follows:

I. Fungi affecting forage plants and cereals.
II. Fungi affecting fruits and fruit trees.
III. Fungi affecting forest trees.

To the farmer in Iowa the diseases under the first head are of the greatest importance since the wealth of the State depends largely upon successful grain and forage crops.

I.—FORAGE CROPS AND CEREALS.

Diseases of wheat.—Aside from the usually common grain rusts (*Puccinia graminis*, and *P. rubigo-vera*) a serious disease of the wheat has appeared in the so-called "blight," or "scab," as the disease is called in different parts of the country. This disease causes the upper part of the head to dry up and ripen prematurely. Although I have not made a thorough study of the disease it seems to be due to a fungus described by Worthington G. Smith* as *Fusisporium culmorum*. The genus *Fusisporium* is placed by Saccardo with *Fusarium*. In all probability Smith's species is one of the others affecting grains, but I have not compared them. The mycelium of the fungus is white or yellowish and permeates the kernel and flower. According to Smith the spikelets are glued together by a gelatinous substance produced by the threads and this causes their death. The hyphæ when placed in a nutrient solution produce an abundance of fusiform septate spores. It should be remembered that the genus *Fusarium* contains many representatives which are entirely saprophytic. Thus *Fusarium solani*, which is destructive to tomatoes, is not able as Prof. Galloway† has shown, to cause rot unless the tissues are somewhat disorganized. *Cladosporium herbarum* is not an uncommon fungus on "blighted wheat heads," and Frank ‡ has shown that it is parasitic on the heads and leaves of various grasses. This disease seems to have been known for a long time in Iowa. Prof. Bessey so stated at the Indianapolis meeting of the Society for the Promotion of Agricultural Science; and it is also found in many parts of the United States, as Prof. Galloway stated at the same meeting. Dr. Weed has found it very destructive in parts of Ohio. Some varieties are more subject to the disease than others. Thus winter wheat was not subject to it nearly as much as some of the most highly prized of the hard wheats like the Saskatchewan.

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* *Gloeosporium nervisequum*, (Fckl.) Sacc.

Diseases of Barley.—Barley on the college farm at Ames this year, aside from the "rusts" and "smuts," has been subject to two diseases. One, *Scolecotrichum graminis*, Fuckl.,§ which has long been known as a serious pest to orchard, timothy,‖ and other grasses.¶ The diseased leaves are marked with brown, or purplish brown, spots, which appear on the leaves transversely. The hyphæ, which are sometimes septate, make their way through the stomata and bear the small brownish spores at the end, or sometimes laterally. The fungus occurred on all of the varieties.

The other fungus is *Helminthosporium graminum*, Rabh. This appears earlier and is more destructive. Mr. Ellis, to whom specimens were submitted, writes that the fungus is, without doubt, Rabenhorst's *Helminthosporium graminum*, and this is the same as *H. inconspicuum*,

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* Diseases of Field and Garden Crops, p. 208.

† Report U. S. Dept. Agriculture, 1888, p. 339.

‡ Krankheiten der Pflanzen, p. 580.

§ Trelease, Dept. of Agrl. Report 1886. p. 129, Plate VII. Ellis, N. Am. Fungi, No. 1988 *a* and *b*.

‖ Bidrag till Kannedomen om vara odlade vaxters sjkdomar. pp. 185, pl. 9. Sorauer Just Bot. Jahresb. 1885 p. 502.

¶ Saccardo Sylloge fungorum, Vol. IV. p. 348.

C. & E.* and Passerini's *H. turcicum.*† The specimens in Ellis's North American Fungi were found on dead leaves of *Zea Mays.* Passerini's specimens were also found on the species, and he attributed it to the fungus he has described. Briosi and Cavara‡ have described, figured, and distributed the same fungus in their collection of parasitic fungi. In their spores these species seem to agree well enough with Rabenhorst's *H. graminum,* which was found by Caspary§ on barley. Frank‖ considers it to be only a well developed *Cladosporium.* In 1885 Eriksson¶ found a disease on barley, near Upsala and Stockholm, which he considered identical with that found by Caspary on barley in Germany. The Iowa barley disease agrees with Eriksson's, but differs from the corn disease found by Passerini. According to this observer the leaves of corn affected by the fungus are at first yellow, then become more or less discolored, and finally wilt.

The spots in the specimens distributed by Briosi and Cavara on corn are sharply limited and extend across the veins. This disease manifests itself long before barley has "headed out." In this barley disease the spots extend from the base to the very tip of the leaf in parallel rows. The diseased leaves form quite a contrast to those of the adjoining healthy plants, as they are variegated pale yellow and green. All the stalks of a stool are affected. The plants die prematurely, and soon after death the leaves become torn into shreds. An examination of the affected parts when the variegated linear stripes appear shows a colorless mycelium permeating the tissues of the leaf. Later a number of erect septate hyphæ appear through the stomata or they break through the epidermis, bearing large three to six celled spores at the end. Occasionally one finds these hyphæ branched. The mass of brown hyphæ and spores along the veins can be easily seen with the naked eye. The spores germinate readily, often a number of germinating tubes coming from a single spore. I have also found the *Helminthosporium* where *Scolecotrichum,* and *Cladosporium graminum* had appeared, but not in such abundance.

The usual amount of smut has occurred during the past summer. *Ustilago segetum* of oats, barley, and wheat and *U. Maydis* of corn have done an unusual amount of damage. Grasses have also been affected by several kinds of smut, some of which are quite destructive.

Timothy Smut, (*Tilletia striæformis* (Westd.) Magnus).—Not only did this fungus occur on timothy growing on the campus, but quite seriously in the field as well. It is known to occur on many grasses in Europe* like *Alopecurus*, *Briza*, *Poa*, *Anthoxanthum*, *Milium*, *Holcus*, *Avena*, etc. In this country it is known to occur on *Agropyrum repens*, *Elymus Canadensis* var. *glaucifolius*.† I think it does not generally occur here on blue grass, but I have found it on that host in Cambridge, Mass. Last summer it was also found on the same host at Ames, where it was growing among timothy, forming the same lead-colored patches it does on that grass. I did not, however, observe that the leaves were afterwards torn into shreds, as it was cut soon after the fungus appeared. Very likely it does so, as it seems to be common when fungi attack grasses, especially along the veins of the leaf.

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*Ellis N. Am. Fungi No. 45. Grevillea Vol. VI, p. 88.

†La nebbia del granturco. pp. 3. Parmia Schroter Just, Bot. Jahresb. 1878, p. 184.

‡Fungi Parassiti delle piante cultivate od utili essicati delineati e descritti. Fasc. III and IV, No. 81.

§ Herbarium Mycologicum No. 332.

‖ Krankheiten der pflanzen, p. 582.

¶ Ueber eine Blattflecken Krankheit der Gerste aus den Berichten der Botaniska Söllskapet i Stockholm. Bot. Centralbl. Vol. XXIX, p. 89. Sorauer Just Bot. Jahresb., 1885, p. 515. Distributed in Fungi Scand. No. 187.

Brome Smut, (*Ustilago bromivora*, Fisch. de Waldh. var. *macrospora*, Farlow.) *Tall Meadow Oat Smut*, (*Cintractia aveneæ*, Ellis and Tracy).—Early in June Mr. F. A. Sirrine called my attention to several smuts occurring on some of the cultivated grasses in the plats of the experiment station. The first (*Ustilago bromivora*, Fisch. de Waldheim) is apparently the variety *macrospora*‡ of Farlow. It occurs abundantly on one of the best of our native species of *Bromus* (*B. breviaristatus*) and it has been reported on *B. ciliatus*, by Dr. Halsted. It affects the inflorescence so as to completely destroy it. This smut will probably not occasion much loss, as it attacks the inflorescence and the grass can be cut before it appears, but it must greatly injure its vitality.

The second destructive smut was found on *Avena elatior*. This was more common than the Brome smut and seems to be the same as has been found by Prof. Tracy in Mississippi on the same host, and called *Cintractia aveneæ*, Ellis and Tracy.§ It transforms the ovary into a compact mass, which is made up of small brownish spores.

This year *Ustilago panici-miliacei* (Pers.) Wint., was very common on *Panicum capillare* and *P. sanguinale*, completely destroying a large number of the plants. Last year it was noticed abundantly only on the latter host, none being found on *Panicum capillare*. It was observed on the latter by Prof. Arthur ‖ some years ago about Ames. This fungus does not seem to differ from *U. syntherismæ* occurring on the sandbur (*Cenchrus tribuloides*), and unless experiments have been made to decide whether Panicum smut can be transferred to the sandbur and *vice*

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* J. B. De Toni in Saccardo Sylloge Fungorum, Vol. II, p. 484. Winter Die Pilze, Vol. I, p. 108. The following hosts are given by Winter: *Agrostis stolonifera*, *A. vulgaris*, *Calamagrostis Halleriana*, *Milium effusum*, *Holcus lanatus*, *Avena elatior*, *Briza media*, *Poa pratensis*, *Dactylis glomerata*, *Festuca ovina*, *F. elatior*, *Bromus inermis*, *Lolium perenne*.

† Trelease, Smut of Timothy. Dept. of Agrl. Report. Ellis North American Fungi, No. 1498.

‡ Bull. Iowa Agrl. College, 1886, p. 59. Saccardo Sylloge fungorum, Vol. VII, p. 461. Winter l. c., Vol. 1, p. 77.

§ Journal of Mycology, Vol. VI, p. 77.

‖ Bull. Iowa Agrl. College, 1884, p. 172.

versa, they should be placed together. I mention these cases to show how destructive some fungus diseases are some years and they do not appear at others.

Clover Rust, (*Uromyces trifolii*, Alb. & Schw.) Wint., is referred to by Prof. Dudley in a recent bulletin as occurring on red clover in New York in a very destructive way. I think it has not been previously reported on that host in this country, though occurring abundantly on it in Europe, according to Frank, Kraft, and others. Clover rust has long been known to occur on white clover in this country, and is at times quite destructive. In August my attention was called to the rust occurring on the campus close to the botanical laboratory. The plants affected were somewhat trodden, but nearly every stalk had its leaves badly diseased. The affected plants soon withered. After the first discovery the rust was soon noticed some 30 feet away, attacking the leaves and stems. It was quite general, as students brought specimens in from the field and various places on the college farm and campus. During the months of August, September, and early October, only uredospores were found, but later teleutospores were produced very abundantly. The stems were marked with longitudinal brownish sori so thick that in touching the plant the hands were colored brown. The teleutospores made their appearance first on the stems, and later they appeared on the petioles and leaves.

Uromyces trifolii also occurs on crimson clover (*Trifolium incarnatum*).* Some years ago it was very bad in an experimental plat at Madison, Wis. The fungus is more destructive to this plant than to red clover. It has also been found on the same host at Ames by Mr. Sirrine. In this country the fungus has been principally reported as destructive on white clover, and commonly all three stages occur on it. Miss Howell has recently shown that the fungus on red and on white clover is identical, and that the uredo and teleutospores can be produced from the æcidium which appears early in the summer.

II.—FRUITS AND FRUIT TREES.

Plum Scab or Black Spot.—For two seasons I have watched with some interest a fungus which causes the plums of some of the cultivated varieties of *Prunus Americana*, especially the Miner, to become spotted and more or less scabby. So far as I know this has not been recorded before, though Professor Osborn informs me he has observed a similar appearance for some years. It is not improbable that the disease may be quite common in the Northwest. The cause of the spotting is a parasitic fungus which seems to be closely related to the fungus causing the black spot disease of peaches (*Cladosporium carpophilum.*) The last species was described by Felix Von Thümen in 1887† and he records it as very troublesome in that year and the year before. Recently Prof Arthur* has recorded it as very widespread in Indiana, and Dr. Erwin F. Smith† as quite destructive in Delaware, Michigan, etc. Professor Galloway, who has kindly allowed me the use of his unpublished notes, records it as very destructive in many parts of the United States. The principal loss results from unattractive peaches and premature decay, due to *Monilia fructigena* and other saprophytic fungi. In Texas I have seen many peaches affected by it, especially the late varieties. The plum fungus differs in some respect from the peach, but this may not be sufficient to make a new species.

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* Trelease Parasitic Fungi of Wisconsin, No. 152, p. 21.

† Symb. Mycol., p. 107.

So far I have only found the fungus on the fruit, but the peach fungus is recorded by Prof. Galloway on the leaves as well. When plums begin to ripen, or are just turning in color, small round patches not larger than a pin head make their appearance. They are pale greenish or grayish in color. These spots increase in size till in some cases they are half an inch across. They are usually round, with a somewhat paler border. In older specimens the patches are frequently confluent and of darker brown color. In very old specimens, especially in those. where the fruit has undergone decomposition, the patches become black and uneven.

An examination of the small grayish spots shows a nearly colorless mycelium creeping over the surface. In the darker portions of the large patches are septate hyphæ. In some cases these can be seen to come through cracks in the cuticle. They are irregular in outline and frequently bent. As the material becomes older a dense stroma of short brownish hyphæ appears. It lies between the cuticle and the cellulose layers of the cell wall. In cross section the hyphæ are more or less angular in appearance, but when free they are rounded. This stroma, especially under favorable conditions, keeps on producing the erect septate hyphæ, which bear the slightly colored spores at the end. They are oval in form, pointed at the end, and usually two celled. The spores germinate readily when kept in a moist chamber, producing a colorless tube.

The fungus itself does not impair the qualities of the fruit, as the injury is little beyond where the spot appears, affecting only three or four layers of cells underlying the spot. Outside of the spot the tissues have their normal appearance. The cell contents of the affected parts are brown and dead. This death of cells causes a loss of water, and, as a result, small cracks appear in the cuticle through which the hyphæ can readily enter the plant. But this entrance, so far as I have observed, is only superficial, never in the epidermal layer, nor even beyond the cellulose layer of the cell wall of the epidermal cell. It is not uncommon to find large cracks or rifts through the outer patches. Plums affected by this fungus invariably show *Monilia fructigena*, putrefactive bacteria, and less commonly *Rhizopus nigricans*, which cause a rapid decay of the fruit. A number of affected plums were placed in a moist chamber and these were soon covered with a vigorous growth of *Monilia*, its mycelium spreading in all directions. Its growth subsided in a few weeks, when mycelial masses were formed.

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* Bull. Agrl. Experiment Station, Indiana, No. 9, 1889.

† Jour. Mycology, Vol. v. p. 32.

The plum fungus seems to differ chiefly from the one occurring on peaches in the shorter hyphæ and somewhat smaller spores. Those on the peach are occasionally borne laterally. The more vigorous hyphæ of the peach may be due to physiological causes. Mr. Ellis, to whom specimens were submitted, thinks it is a distinct species.

Anthracnose of currants, (*Glœosporium ribis* (Lib.) Mont. and Desm.).—Attention has been directed to this disease by several investigators.*

It is very destructive, causing the leaves to become spotted on the upper surface, and to fall long before the proper time. Sometimes the leaves drop early in August. The spores come from small dark-brown specks. When ripe the epidermis breaks, allowing the spores to ooze out in tendrils. It is most commonly found on *Ribes rubrum* at Ames.

Two other destructive diseases have also appeared on currants. One is caused by a species of *Septoria*. The spots are at first brown, later becoming pale on the upper and brown on the under surface. Each spot has a number of small conceptacles, which contain the slender spores. Another disease found on *Ribes rubrum* causes a similar spotting but does not contain conceptacles, the hyphæ breaking through the epidermis and bearing the *Cercospora* spores. Both of these fungi cause the leaves to drop prematurely. The Septoria disease is the more destructive.

Cylindrosporium padi, Karsten.—It has become practically impossible to grow good cherry seedlings on account of this fungus. Leaves begin to fall early in June, and where cherries are budded the young growth continually produces spores throughout the season.

The cluster cup fungus of gooseberries (*Æcidium grossulariæ* DC.) has been very destructive to cultivated gooseberries and a common cultivated shrub, *Ribes alpinum*. It not only affects the leaves but causes the fruit to become greatly distorted and worthless.

Black knot (*Plowrightia morbosa*), although occurring abundantly on a large number of hosts of the genus *Prunus*, is especially destructive to wild plums and cherries in this State (*Prunus Americana*, *P. serotina*, *P. Virginiana*), frequently causing the death of the plant in a few years. It is not uncommon to find it on *Prunus domestica*, and within the last year it has been found on one of the Chinese apricots (*Prunus Armeniaca*) on the college grounds. The tree upon which the fungus was found has been subject to much pruning, and possibly infection has been brought about in this way. It is not improbable that the pruning has lowered its vitality and rendered it liable to the disease.

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*Dudley, Agric. Exper. Sta., Cornell Univ., Ithaca, Bull. 15, p. 196; Peck, 38th and 43d Report N. Y. State Mus. Nat. Hist., p. 98, 6; Seymour, American Garden, Vol. XI.

Vibrissea hypogæa has also been found at Ames on an old dead grape root.

White rust of beets.—Late in October, when the beets were being harvested, one of the students, Mr. W. Zmunt, brought a leaf of the common beet, which showed several white pustules which proved to be a *Cystopus*. A careful search through other herbaria has shown more specimens. I have not seen the oöspores, so I can not say to which species it belongs, but the conidia resemble those of *Cystopus bliti* (Biv.) de Bary. This has not been recorded as occurring on any of the Chenopodiaceæ in the United States. Frank,* Sorauer,† Berlese, and De Toni‡ record it as occurring on *Chenopodium*, a genus closely related to *Beta*. Here again we are confronted with the question why this *Cystopus* should affect the beet in Iowa and apparently has not been found on this host in other parts of the world. It certainly seems that if the fungus had occurred commonly it would have been observed before.

III.—FOREST TREES.

Thus far I have not observed *Glœosporium nervisequum* on sycamore trees in the vicinity of Ames, but a fungus giving the leaves of *Æsculus glabra* a similar scorched appearance was found early in August. It is due to the parasitic fungus *Phyllosticta sphæropsoidea*, E. and E. By the middle of September many of the leaves were dry and had fallen from the trees.

Cedar-apple fungus.—So far as I know the only recorded species for this locality is *Gymnosporangium macropus*, but last spring a second species, *G. globosum*, was found infesting one of the cedars. *G. macropus* is the common species in Illinois, Wisconsin, and Iowa, and I think is the common "cedar apple" in most parts of the United States. Dr. Halsted§ concluded that we have only one species in this locality. I found only a single specimen of the other after a diligent search. It might in this connection be interesting to state that some of the wild crab apples close to *Juniperus Virginiana* have been so severely attacked by *Rœstelia pyrata* that not only was every leaf affected but the fruit and young branches as well. The young branches usually died, so that the trees are in a bad condition. It was also noticed that before *Gymnosporangium macropus* appeared the leaves coming from the small lateral branches were yellow, as if they had been infested by the fungus. Other duties have prevented my studying these early yellow leaves carefully. Dr. Farlow* refers to *Rœstelia aurantiaca* as possibly being perennial.

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* Krankheiten der Pflanzen, p. 419.

† Pflanzenkrankheiten, Vol. II, p. 175.

‡ Saccardo Sylloge fungorum, Vol. VII, p. 236.

§ Halsted, Bull. Iowa Agric. College, Botanical Dept., 1886, p. 63. Report U. S. Dept. Agriculture, 1888, p. 370.

Marsonia juglandis (Lib.) has been quite destructive to *Juglans cinerea* and *J. nigra*, causing brown spots to appear on the leaves. Trees thus affected lose their foliagepre maturely. *Marsonia Martinii* Sacc. and Ell., commonly occurred on *Quercus alba* and *Q. rubra*, causing pale colored spots with two-celled spores. *Phyllactinia suffulta* occurred destructively on *Fraxinus* at Ames the past summer.

REMARKS ON THE FUNGUS OF A POTATO SCAB.

(*Spongospora solani* Brunch.)

By Prof. G. de Lagerheim.

In purchasing some potatoes at a market in Quito for use in bacterial cultures, I noticed while cleaning them that they were affected with black warts. An incision into these warts convinced me that they were caused by the fungus *Spongospora solani*, described by Brunchorst† several years ago. This disease is said not to occur in North America,‡ as the disease known as "scab" is there produced by other fungi. Since South America is the home of the potato, it seemed to me of interest to study this disease here. The disease is generally known in Quito, and manifests itself on potatoes from various localities. It is called "Cara,"§ and is supposed to be occasioned by the gnawing of worms.

The microscopic appearance and the behavior of the warts coincide fully with the description and illustration given by Brunchorst (loc. cit., p. 219, Plate I, Fig. 2). While the microscopic illustrations of Brunchorst were quite accurately drawn, they were, nevertheless, altogether erroneously interpreted. The wart-forming tissue, which he considers as a part of the potato altered by the disease, is the pseudo-parenchyma of fungus hyphæ, in which the characteristic spore balls arise. The fungus is, therefore, not a Myxomycete, and has no relation to Plasmodiophora. In cross sections of the warts hyphæ are often seen growing out of the pseudo-parenchyma, their membranes being precisely of the same color as the cells of the pseudo-parenchyma. The membranes of the hyphæ are of a more or less purple-brown color. In a wart that does not yet contain spores the hyphæ are filled with a colorless protoplasmic substance, which is very often full of vacuoles. It is perhaps

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* Farlow: The Gymnosporangia or Cedar Apples of the United States. Memoirs Boston Soc. Nat. Hist.

† Regarding a very widespread disease of the tubers (Bergens Museum, Aarsberetning, 1886) Bergen, 1887.

‡ According to Thaxter. Report of the Mycologist, p. 6 (Fourteenth Annual Report of the Connecticut Agricultural Experiment Station, 1890), New Haven, Connecticut.

§ A word from the Quichua language, which means scab in English, or *sarna* in Spanish.